

Mobile Incineration: An Analysis of the Industry

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MOBILE INCINERATION:
An Analysis of the Industry

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and
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TABLE OF CONTENTS

	<u>Page No.</u>
EXECUTIVE SUMMARY	E-1
1. INTRODUCTION	1-1
2. THE SUPPLY OF MOBILE INCINERATION	2-1
2.1 Company Profiles	2-2
2.2 Mobile Incineration Capacity	2-5
2.3 Market Segmentation and Company Strategy	2-10
2.4 Economics of Mobile Incineration	2-15
3. THE DEMAND FOR MOBILE INCINERATION	3-1
3.1 Superfund	3-1
3.2 Department of Defense Cleanup Activity	3-12
3.3 RCRA "Live Stream" Wastes	3-23
3.4 TSCA PCB Wastes	3-23
4. MARKET ANALYSIS	4-1
4.1 Current Market	4-1
4.2 Advantages of Mobile Incineration	4-5
4.3 Obstacles	4-5
4.4 Future Market	4-9
APPENDIX A List of Contacts	A-1

LIST OF TABLES AND FIGURES

	<u>Page No.</u>
Table E-1 Projected Mobile Incineration Units and Capacity as of the End of 1989.....	E-3
Table 2-1 Mobile Incineration Units Categorized by Size	2-6
Table 2-2 Existing Mobile Incineration Capacity by Company ...	2-8
Table 2-3 Estimated Capacity of New Mobile Incineration by End of 1989	2-9
Table 2-4 Estimated Number of Mobile Incineration Units by End of 1989	2-11
Table 2-5 Estimated Total Capacity of Mobile Incineration by End of 1989	2-12
Table 3-1 Federal Superfund Obligations	3-3
Table 3-2 Superfund Records of Decision Specifying Onsite Incineration (FY87 and FY88)	3-10
Table 3-3 Chemical Weapons Stockpile Disposal Program Funding Requirements by Fiscal Year	3-14
Table 3-4 DOD Installation Restoration Status: 1987	3-16
Table 3-5 Twin Cities Army Ammunition Plant Cleanup Costs	3-20
Table 4-1 Completed Mobile Incineration Cleanups	4-2
Table 4-2 Mobile Incineration Cleanups Under Way	4-3
Table 4-3 Likely Mobile Incineration Jobs	4-10

LIST OF FIGURES

	<u>Page No.</u>
Figure 3-1 Funding for Installation Restoration Program	3-19

EXECUTIVE SUMMARY

This report examines the mobile incineration industry, including the supply of and demand for mobile incineration and an assessment of the incineration market. It was prepared for the Regulatory Innovations Staff and the Office of Solid Waste of the U.S. Environmental Protection Agency based on a need to examine mobile incineration that became apparent during EPA's analysis of hazardous waste treatment capacity. EPA wanted to evaluate whether mobile incinerators can absorb the demand that other treatment facilities, such as fixed-base incinerators, cannot handle.

It should be noted that this report was prepared in 1989 and that the findings are based on data available in July, 1988. This is the most current information available to EPA. EPA welcomes comments and additional information. To comment, contact Linda Malcolm, U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460, (202) 382-4654.

Findings

Interviews conducted with mobile incineration and hazardous waste incineration company officials in June and July of 1988 resulted in three basic findings:

1. There is significant excess capacity of mobile incinerators. Eighteen mobile incinerators are field-ready. These units can burn about 400,000 to 550,000 tons of waste per year. New units are expected to add about 350,000 tons of additional annual capacity. In contrast, mobile units burned only 70,000 tons of waste in 1987 and the first half of 1988. Cleanups totaling 450,000 tons are now under way. Signs of excess capacity are the inactivity of four units and the competitiveness of the bidding. The slow pace of Superfund and Department of Defense (DOD) cleanup commitments, coupled with idle capacity in mobile units, has led companies to aggressively price mobile incinerator services.

2. The industry should be able to meet expected demand and can increase capacity quickly to meet additional demand, despite the unsettled condition of the market. Approximately 750,000 to 900,000 tons of capacity will be available over the next year, while near-term demand in new jobs may exceed 600,000 tons. Additional units to meet demand can be ready within a year of an order.
3. The timing and magnitude of Federal remediation activities are impacting the mobile incineration market. Many companies hence found the procurement process and Federal contractual requirements to be a barrier to entry into the market. On the other hand, the public appears to have responded favorably to mobile incineration and thus it is an attractive remediation option.

As of July 1988, 18 commercially operating or field-ready mobile incinerators were available and 4 units were in pilot stages. Twelve of the commercial units are rotary kiln, two are circulating bed, three are infrared, and one uses a plasma torch technology. Ten companies own these field-ready machines, and the total capacity is estimated to be 400,000 to 550,000 tons per year. This capacity estimate is based on capacity utilization of 50 percent and 24-hour-per-day operation. Fifteen new units are expected to be added during 1989, representing about 350,000 tons of new capacity. Based on conversations with mobile incinerator vendors, the lead time for construction of a mobile incinerator is approximately 1 year. Table E-1 summarizes projected industry capacity and units by company.

Demand for Mobile Incineration

Mobile incinerators processed approximately 70,000 tons of wastes between January 1987 and June 1988, primarily at Superfund and DOD remediation sites. Companies in the mobile incineration business expect that most future demand will be for remediation of Superfund or other hazardous waste sites. Specific areas of interest include:

Table E-1 Projected Mobile Incineration Units and Capacity as of the End of 1989

Company	Units		Capacity (tons)	
	Total	Percent	Total	Percent
Chemical Waste Management	2	6	50,370	6
Ecova	2	6	35,040	4
ENSCO	6	18	219,000	27
Envirite	1	3	65,700	8
IT	4	12	173,010	21
John Zink	1	3	28,470	3.5
Kimmins/Incin.	1	3	4,380	1
Ogden	3	10	52,560	6
O.H. Materials	1	3	30,660	4
Riedel	1	3	30,660	4
Rollins	1	3	15,330	2
Roy F. Weston	1	3	28,470	3.5
Vesta	5	15	32,850	4
Westinghouse	4	12	50,370	6
Total	33	100	816,870	100

Source: Company interviews.

- o Superfund Emergency Response: Emergency response actions have provided many companies with mobile incineration experience, and make up a significant proportion of the 70,000 tons of material burned by mobile units to date. These tend to be small jobs, best-suited for smaller units.
- o Superfund Remedial Action: Most companies view these longer term cleanup actions as offering the greatest potential for mobile incineration. Twelve Records of Decision (RODs) signed in FY87 and FY88 specify onsite incineration. Several sites have over 100,000 tons of material to be treated.
- o State Superfunds: So far, State programs have not been a source of work for mobile incinerators, with one significant exception. The State of Illinois obtained a statutory exemption from RCRA permitting requirements for mobile incineration at State Superfund sites. Three sites in Illinois are using mobile incinerators.
- o Privately Funded Cleanups and Corrective Action: Permitting obstacles plus slow progress on private cleanups have limited activity in this market.
- o DOD Installation Restoration Program: DOD has estimated that it will spend \$10 to \$14 billion (FY87 dollars) over the next 20 years on site remediation. A mobile incinerator was used at the Cornhusker Army Ammunition Plant (Nebraska) and is scheduled for use at the Louisiana Army Ammunition Plant (Louisiana).

Superfund and DOD remediation programs are expected to generate roughly 650,000 tons of demand over the next 2 years. The pace of Federal remediation contracting will determine the timing of these jobs.

Market Analysis

Mobile incinerators offer several important advantages over offsite waste treatment and disposal options, including incineration. The public tends to favor onsite mobile incineration, especially relative to onsite alternatives such as land filling and fixed-base incineration. Mobile incineration is attractive because it is viewed as a temporary operation that will fix a potentially "long-term" problem. Furthermore, onsite

incineration can avoid the significant costs and risks involved in transportation to offsite facilities, whether for incineration or other types of management.

Despite these clear advantages, the market for mobile incineration has been slow to develop. As of mid-1988, 4 of the 18 commercial field-ready mobile incinerators were idle. Furthermore, the total tonnage handled by the active machines during the preceding 12 months (70,000 tons) was well below their capacity of about 500,000 tons per year.

The moderate capital costs associated with mobile incineration, relative to fixed-base options, will ensure that capacity becomes available to meet demand as it arises. However, companies site three primary obstacles that may be critical to the development of this market. These obstacles center around the government permitting and procurement processes, and are described in more detail below.

1. RCRA Permitting Process. Resource Conservation and Recovery Act (RCRA) wastes have not been a viable market for mobile incinerators. The length and site specificity of the permit process pose a barrier that companies find uneconomic to overcome. The permit process has also been an obstacle to onsite mobile incineration of privately sponsored corrective actions.
2. Aggressive Competition. Excess mobile incineration capacity is exerting downward pressure on prices and forcing new entrants to the market to have units available to compete with existing field-ready units. Companies are bidding low to win contracts and thus gain experience and keep units active.
3. Government Procurement Process. Superfund and DOD remedial actions are a major market for most companies, but they are finding these procurements difficult. For smaller companies, costs of proposals and bonding are an insurmountable barrier. In addition, treatment specifications may eliminate mobile incineration as a suitable technology, since they may be based on out-of-date information on technology costs and viability. Finally, the unpredictable timing of Federal funding and

contracting makes it difficult for companies to plan and respond to Federal needs. As a result, companies have become conservative about moving ahead on plans for expanding their mobile incineration business.

1. INTRODUCTION

This report examines the mobile incineration industry, including the supply of and demand for mobile incineration and an assessment of the mobile incineration market. The study was prepared for the Regulatory Innovations Staff and the Office of Solid Waste of the U.S. Environmental Protection Agency in Washington, D.C., and is based on an earlier analysis of the hazardous waste treatment industry's capacity to treat wastes and problems the industry was facing in siting permanent facilities. EPA chose to examine the mobile incineration business further because of its potential to absorb the excess demand that could not be handled by fixed incineration facilities.

The primary sources of information were interviews with EPA and State officials and representatives of companies with mobile incinerators. Several major hazardous waste remediation firms and companies planning to enter the mobile incineration market were also consulted. A review of periodicals and materials supplied by contacts supplemented the interviews.

The reader should keep in mind that the mobile incineration business is evolving rapidly. While this report is up to date as of July 1988, several industry officials were contacted in January 1989, to ensure that the report's conclusions were still sound. The officials agreed that the findings were still applicable.

Sections 2 and 3 describe the supply and demand characteristics of the mobile incineration business. These factors are then brought together in the final section, which analyzes the market in aggregate.

2. THE SUPPLY OF MOBILE INCINERATION

Mobile and transportable incineration technologies encompass a variety of nonfixed-base incineration techniques. For purposes of this report, the term "mobile incineration" refers to both mobile and transportable units, although the more specific description of "transportable" is used when a distinction is necessary. These technologies are adapted for transportation and scaled to meet a particular size and type of job. The primary types of technology used are rotary kilns, circulating bed combustion, and infrared treatment.* Other technologies, which are considered "thermal" because they do not use a flame, are mostly in pilot form.**

The size of these incineration units varies from being truly mobile on a single flatbed truck trailer to being transportable on 10 to 60 truck trailers or railroad flatcars. The terminology of the industry generally classifies as "mobile" a unit that is used on its truck trailer, while a "transportable" unit is assembled at the site and

* For a more comprehensive description of the design and engineering of mobile incineration technologies, consult Mobile Treatment Technologies for Superfund Wastes (EPA 540/2-86/003(f)), September 1986. If more up-to-date information is needed, the reader should contact the companies directly. A list of the people interviewed can be found in Appendix A of this report.

** Penberthy Electromelt and Westinghouse Environmental Services units heat the waste material, and the residual is incorporated into a bed of molten glass. When cooled into a solid, the glass has completely stabilized any residual wastes. The companies believe that these technologies are especially useful for wastes high in metals and organics.

requires significant site preparation, including concrete pads and utility services. Small units can be ready to use in a few days; large units usually require 1 to 2 months to set up.

2.1 Company Profiles

A total of ten companies with commercial mobile incineration capabilities were identified. These firms are described below:

- o Envirite (Plymouth Meeting, Pennsylvania) has waste treatment facilities and provides field services. The company has one large transportable rotary kiln, presently located at the Prentiss, Mississippi, Superfund site.*
- o Environmental Systems Company (ENSCO) (Little Rock, Arkansas) provides a wide range of environmental services and owns the single largest fixed-base incinerator in the United States, located in El Dorado, Arkansas. ENSCO has five rotary kilns: one is working at an Illinois site (Lenz Oil); one is operating as a fixed unit at the El Dorado site and has recently been awarded a final EPA (Part B) operating permit; one is in Gulfport, Mississippi; and two are in storage. In addition, ENSCO is constructing a sixth, larger unit.**
- o Kimmins Environmental (Tampa, Florida) is a full-service hazardous waste and asbestos remediation company. In cooperation with Incinerex, Kimmins has one rotary kiln unit working at the Southern Crop site in Del Ray, Florida. Kimmins has also brought in a second kiln, which is owned and run by Vesta. Kimmins has an option to purchase the Incinerex unit.
- o International Technology Corporation - IT (Irvine, California) is a major national provider of engineering, assessment, and remediation services. The company has a large transportable rotary kiln that just completed a job at the Cornhusker Army Ammunition site in Nebraska. It is moving the incinerator to its next job at the Louisiana Army Ammunition plant.

* Williams Environmental purchased Envirite's field services unit in December 1988.

** As of January 1989, ENSCO is ceasing operation of its field services and will attempt to sell its mobile incinerators.

- o Ogden Environmental Services (San Diego, California), a unit of Ogden Corporation, was formerly the Hazardous Waste Management Division of GA Technologies Inc. It acquired the rights to the circulating bed combustion technology in 1986. It has two mobile units using this technology. Ogden is operating one unit at ARCO's Swanson River Field in Alaska. The second will clean up about 7,000 cubic yards of contaminated soil at the former Tillie Lewis Cannery site in California.
- o O.H. Materials (Findlay, Ohio), a unit of Environmental Treatment and Technologies Corporation, primarily offers remediation and emergency response services. The company has two EPA Emergency Response Cleanup Services (ERCS) contracts for Zones 1 and 2. The company has one infrared unit, which was originally purchased from Shirco, and recently concluded an incineration job at Indiantown, Florida.
- o Reidel Environmental Technologies (Portland, Oregon), EPA's ERCS contractor for Zone 4 (Regions VI-X), took delivery on a \$3 million Shirco mobile unit in 1987. According to company contacts, the machine is currently inactive.
- o Vesta Technologies (Fort Lauderdale, Florida) was formed in 1986 purely to build and operate mobile hazardous waste incinerators. Vesta is supported financially by Attwoods, PLC, an English solid waste handling corporation. The company has three small rotary kiln units, which have worked at a number of sites.
- o Westinghouse Environmental Services (Madison, Pennsylvania), part of Westinghouse Electric, has two commercial units. One is an infrared system purchased from Shirco. It is being used at the LaSalle, Illinois, site. The second unit, using a "pyroplasma" process, is similar to plasma torches that have been used in applications such as blast furnaces, boiler ignition, and the testing of atmospheric reentry heat shields. The company also has a pilot electric pyrolyzer system that incorporates inorganic materials into a glass matrix.
- o Roy F. Weston (West Chester, Pennsylvania) is a leading EPA contractor under the Emergency Response Technical Assistance Team (ERTAT) program and the Alternative Remedial Contracting Strategy (ARCS) program. The firm has one rotary kiln, now in use at the Beardstown Lauder Salvage Yard site in Illinois.

In addition to these ten firms, three companies have pilot units and firm plans for commercial units, and two other companies have plans to enter the market:

- o Chemical Waste Management (Oak Brook, Illinois) is the largest full-spectrum hazardous waste treatment, disposal, and remediation company in the United States, with revenues in 1987 of \$558.6 million. While it does not have any mobile or transportable incinerators at the moment, the company expects to have two units ready for service by the end of 1988.
- o Ecova Corporation (Redmond, Washington), which labels itself the "Microbial Ecology Corporation," has focused on biological treatment of hazardous wastes. When Shirco declared bankruptcy in late 1987, Ecova entered into an agreement to purchase that company's assets, primarily the patent for Shirco's infrared incineration system. This purchase represents Ecova's first foray into the incineration business. At the time of this report, Ecova had two mobile units under construction but did not yet have a field-ready mobile incinerator.
- o Rollins Environmental Services (Wilmington, Delaware) is the largest incineration company in the United States, with three fixed-base facilities. The firm expects to have a rotary kiln ready for commercial use in the fall of 1988.
- o John Zink (Tulsa, Oklahoma) has traditionally been a manufacturer of incinerators and incinerator components. The company recently decided to construct and operate its own mobile units and enter the remediation market. The company plans to build both a mobile rotary kiln and an infrared unit.
- o Penberthy Electromelt (Seattle, Washington) has historically constructed kilns for glass production. In 1979, the firm became interested in the potential of its technology for disposal of waste materials such as asbestos, and later from PCBs and other hazardous wastes. The firm had a pilot unit using a patented process that incorporates the ash from the waste into a surface of molten glass. When cooled, the wastes are stabilized in the solid material.

The U.S. Environmental Protection Agency also has a rotary kiln unit, which is classified as a pilot unit in this analysis.

2.2 Mobile Incineration Capacity

Mobile incinerators range in size from small, 1- to 2-ton-per-hour units to units that can process more than 10 tons per hour. Smaller units can be transported on 2 or 3 truck trailers; larger units may require up to 60 trailers. Mobilization of smaller units, which may remain on their trailers during use, may take several days. Larger units are assembled onsite and may take 1 to 2 months for setup and shakedown.

As of July 1988, 18 commercially operating or field-ready mobile incinerators and 6 pilot-sized units were available for use. The distribution of these units by size and type is shown in Table 2-1. IN general, the five units falling into the "less than 3.5-tons-per-hour" category are small and can handle sites under 5,000 tons economically.* The 11 units in the "4- to 10-tons-per-hour" category can handle a wider range of sites and are best-suited for those ranging from 10,000 to 50,000 tons. The two largest units can handle sites of over 100,000 tons in a reasonable period of time.

Based on information provided by the companies, the combined capacity of all current mobile incinerators is 88 to 124 tons per hour, or 2,000 to 3,000 tons per day. This assumes 24-hour-per-day operation, which is typical of most machines.

* This categorization is based on discussions with company representatives and other contacts regarding the use of different sized units on various sizes of sites. These groupings reflect the economics of mobile incinerators, which is discussed further on pages 2-15 to 2-17.

Table 2-1 Mobile Incineration Units Categorized by Size
(tons per hour)

	Pilot	<3.5 tph	4-10 tph	>10 tph	Total
Rotary Kiln	2	4	6	2	14
Circulating Bed	1	0	2	0	3
Infrared	1	0	3	0	4
Other	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>3</u>
Total	6	5	11	2	24

tph - Tons per hour.

Source: Company interviews.

Translating this information to a yearly basis, existing units have the potential capacity to process, in total, about 400,000 to 550,000 tons of wastes per year. Note that the actual capacity of these units to burn wastes is highly dependent on site-specific factors. This calculation assumes that the units operate for 50 percent of the year.*

About 70 percent of existing mobile incineration capacity is in rotary kilns, 21 percent in infrared, 8 percent in circulating bed combustion, and 1 percent in other technologies. ENSCO has approximately 33 percent of the total capacity, followed by Envirite with 14 percent and IT with 11 percent (see Table 2-2).

An additional 2,000 tons per day (about 350,000 tons per year) of capacity is likely to be available within the next year, almost doubling the current amount. This capacity will result from the addition of 15 new units, mostly rotary kilns. As shown in Table 2-3, about three-quarters of this new capacity will be added by IT, Chemical Waste Management, Ecova, and ENSCO. In addition, several companies are in a position to add more units quickly if economically justified. Typically, a new unit can be produced and ready to use within 1 year of an order.**

* This is a reasonable but conservative assumption. In addition to normal downtime (typical operating time for a fixed unit is 75 percent), mobile units are not working when they are being transported and set up.

** Several companies stated that they could have a unit ready for the field within 9 months of an order.

Table 2-2 Existing Mobile Incineration Capacity by Company

Company capacity	No. of units	% of total number	Capacity (tons/yr)	% of total
ENSCO	5	28	153,300	33
Envirite	1	5.5	65,700	14
IT	1	5.5	52,560	11
Westinghouse	2	11	41,610	9
Ogden	2	11	35,040	8
Riedel	1	5.5	30,660	7
O.H. Materials	1	5.5	30,660	7
Roy F. Weston	1	5.5	28,470	6
Vesta	3	17	19,710	4
Kimmins/Incin.	<u>1</u>	<u>5.5</u>	<u>4,380</u>	<u>1</u>
Total	18	100	462,090	100

Note: Tons per year based on 24-hour-a-day operation of equipment for 50 percent of the year (182.5 days). If companies supplied a range for equipment throughput, the mean was used to construct this table.

Source: Company interviews.

Table 2-3 Estimated Capacity of New Mobile Incineration
Units by End of 1989

Company	New units	% of total number	New capacity (tons/yr)	% of total capacity
IT	3	20	120,450	34
ENSCO	1	7	65,700	19
ChemWaste	2	13	50,370	14
Ecova	2	13	35,040	10
John Zink	1	7	28,470	8
Ogden	1	7	17,520	5
Rollins	1	7	15,330	4
Vesta	2	13	13,140	4
Westinghouse	<u>2</u>	<u>13</u>	<u>8,760</u>	<u>2</u>
Total	15	100	354,780	100

Source: Company interviews.

Overall, as of the end of 1989, it is likely that there will be a total of 33 mobile incineration units (see Table 2-4). ENSCO will have six units, or 18 percent of the total. Seven companies will have just one unit. Total yearly mobile incineration capacity will be about 800,000 tons per year, based on the same assumptions used in earlier capacity estimates. As Table 2-5 shows, ENSCO and IT will have approximately one-half of the industry capacity, with the remainder distributed fairly evenly among the other 12 companies.

2.3 Market Segmentation and Company Strategy

Companies position themselves in the mobile incineration market in terms of the client for whom they want to work, the size of the site, and the type of wastes that they want to treat. These considerations are discussed in more detail below.

2.3.1 The Client

Companies consciously decide whether to focus on government or private remediation work. The attractive aspects of government work are substantial funding, a large number of cleanup projects, and an open bidding process. On the negative side, government contracting procedures are slow, and competitive bidding can erode margins. Some companies, such as Waste-Tech, are not interested in government work at all. Other firms have made major Superfund contracts their primary focus.

Companies differentiate among Superfund remedial action, Superfund emergency response, and State-sponsored cleanups. Smaller firms report

Table 2-4 Estimated Number of Mobile Incineration Units
by End of 1989

Company	Units			% of total number
	Existing	New	Total	
ENSCO	5	1	6	18
Vesta	3	2	5	16
Westinghouse	2	2	4	12
IT	1	3	4	12
Ogden	2	1	3	9
ChemWaste	0	2	2	6
Ecova	0	2	2	6
O.H. Materials	1	0	1	3
Roy F. Weston	1	0	1	3
Riedel	1	0	1	3
Kimmins/Incin.	1	0	1	3
Envirite	1	0	1	3
John Zink	0	1	1	3
Rollins	<u>0</u>	<u>1</u>	<u>1</u>	<u>3</u>
Total	18	15	33	100

Source: Company interviews.

Table 2-5 Estimated Total Capacity of Mobile Incineration
by End of 1989

Company capacity	Capacity (tons/year)			% of total
	Existing	New	Total	
ENSCO	153,300	65,700	219,000	27
IT	52,560	120,450	173,010	21
Envirite	65,700	0	65,700	8
Ogden	35,040	17,520	52,560	6
Westinghouse	41,610	8,760	50,370	6
ChemWaste	0	50,370	50,370	6
Ecova	0	35,040	35,040	4
Vesta	19,710	13,140	32,850	4
O.H. Materials	30,660	0	30,660	4
Riedel	30,660	0	30,660	4
Roy F. Weston	28,470	0	28,470	3
John Zink	0	28,470	28,470	3
Rollins	0	15,330	15,330	2
Kimmins/Incin.	4,380	0	4,380	1
Total	462,090	354,780	816,870	100

Source: Company interviews.

some difficulty in competing for Superfund remedial action contracts and therefore focus their attention on emergency response actions or State cleanups.

2.3.2 Site Size

The size of an incinerator dictates the minimum economic size of a job. Large incinerators have significant moving and setup costs. These fixed costs, when spread over a small amount of treated material, substantially increase costs per ton of treated material at a small site. On the other hand, larger incinerators can treat large sites very economically, since the fixed costs are spread over many tons of treated material.

Small incinerators, which have lower moving and setup costs, are better-suited for small sites. However, small incinerators do not have the economies of scale of larger units, and thus their costs per ton of treated material remain relatively constant as the size of a site increases.

Companies make strategic decisions on the size of an incinerator to be built based on the segment of the market that they want to address. For example, at the moment, Vesta is using very small, flexible rotary kilns. The advantage of these small units is that they can handle small sites that cannot be remediated economically with larger units, and larger sites can be handled with more than one unit. Other companies,

such as Envirite and IT, have opted to build very large units that can handle sites with over 100,000 tons of material in a reasonable amount of time.*

2.3.3 Waste Types

Cleanups involve a wide variety of waste types and conditions. Companies evaluate the types of situations for which their equipment is best-suited and make equipment purchases based on the type of waste they want to treat. Rotary kilns are the most all-purpose equipment, but they have differing degrees of productivity depending on the Btu content and nature of the waste. Other aspects of equipment configuration, such as the waste preparation and feed system, may affect the types of sites that an incinerator can handle.

A key to success in the mobile incineration business, as with other hazardous waste services, is a company's ability to work with State and Federal bureaucracies. Thus, companies obtain Toxic Substances Control Act (TSCA) mobile permits to broaden the utility of their equipment, although one company representative confessed that the TSCA permit was mostly a marketing tool to demonstrate EPA approval and evidence of a successful trial burn. Several companies market their ability to navigate the permitting process successfully and have developed specific strategies to deal with community concerns.

* One example of minimum economic size appears in a recent O.H. Materials press release, in which the company says that its infrared incinerator is designed "to accommodate the operational and competitive parameters of projects involving 4,000 tons or more of hazardous waste...." Other companies also indicated that they had minimum job size cutoffs.

Most companies in the mobile field have explored the possibility of using the RCRA Research Development and Demonstration (RD&D) program and the Superfund Innovative Technology Evaluation (SITE) program to gain incineration experience. The Superfund SITE program has proven useful to smaller companies and to those with innovative technologies by providing an opportunity to field test their equipment. This experience can reassure potential clients about the viability of the equipment and, hence, can be a useful marketing tool for these companies.

2.4 Economics of Mobile Incineration

Mobile incinerators cost from \$1.5 million to more than \$6 million, depending on the size and technology of the unit. This expense serves as a significant barrier to entry into the market, and smaller companies in particular are reluctant to purchase or build a machine without project commitments. To reduce financial risk, companies may enter into joint ventures with manufacturers or other contractors. For example, Kimmins is gaining experience at the Southern Crop site in Florida by using a machine from Incinerex that Kimmins has an option to purchase. Kimmins also brought in a Vesta unit at that site.

The costs of treating a site are dependent on many variables, including the amount of material to be treated, the condition of the material, the Btu content of the material, and the site location and associated setup and transportation costs. The costs are also dependent on the specifications of the incinerator. For very large units, smaller

sites tend to be less cost-effective; conversely, smaller units may not be cost-effective at sites where large volumes of wastes must be processed.

A key difference between small (mobile) units and large (transportable) units is the cost of onsite setup. For a very large unit, setup may cost \$700,000 to \$800,000. Concrete pads must be prepared, utilities must be supplied, and the unit must be removed from its trailer or flatcar with cranes and then installed. Small units can be set up for under \$100,000.* These differences in fixed costs affect the costs per ton of material treated, especially for small sites.

"Per ton" prices must be interpreted cautiously because of differences in the additional site expenses included in the per ton figures and the fact that figures may or may not incorporate overhead expenses. It appears, however, that prices for mobile incineration services have fallen over the past few years from over \$500 per ton to \$100 to \$350 per ton. On a very small or atypical site, however, prices may still be as high as \$500 per ton.

The wide range in cost per ton figures is largely the result of two factors. First, costs are closely correlated with the Btu content of the material. One company quoted prices for the same quantity of low- and high-Btu material as \$100 and \$350 per ton, respectively. The reason for

* One company cited a small unit mobilization cost of \$28,000.

this difference is that an incinerator's throughput is constrained by the Btu content of a waste material. Fewer tons of high-Btu material can be processed per hour, raising the per ton costs.

Second, some companies are bidding at cost or lower to obtain work and experience. While it is difficult to separate fact from fiction, given the competitiveness of the mobile incineration business at this time, low winning bids, such as that at Prentiss, Mississippi, of \$172 per ton, may be lower than the equilibrium price. However, prices should continue to fall into the \$100 to \$200 per ton range, in part because of aggressive bidding practices and in part because of the increased experience of firms in the mobile incineration market. (The issue of bidding behavior is addressed further in Section 4.)

3. THE DEMAND FOR MOBILE INCINERATION

The market for mobile incineration consists of four major segments:

- o Remediation of CERCLA (Superfund) sites, either Federally or privately funded;
- o Remediation of Department of Defense installations;
- o Treatment of "live stream" hazardous wastes regulated under RCRA; and
- o Treatment of PCB wastes regulated under TSCA.

This section discusses each of these market segments, addressing the potential size, suitability for mobile incineration, and market development.

3.1 Superfund

3.1.1 Background

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), passed in 1980, established a national cleanup fund of \$1.6 billion aimed at correcting problems at inactive hazardous waste sites. Amendments to CERCLA in 1986 (Superfund Amendments and Reauthorization Act, or SARA) increased the size of the cleanup fund by an additional \$8.5 billion, to be spent over 5 years. The amendments also set a strict timetable for EPA action on Superfund sites:

- o Within 3 years of passage of SARA, at least 275 new Remedial Investigation and Feasibility (RI/FS) studies must be started at National Priority List (NPL) sites. If EPA fails to meet this deadline, a secondary requirement takes effect that calls for a total of 650 new RI/FS studies within 5 years.
- o SARA also requires EPA to start remedial action at 175 NPL sites within 3 years and at an additional 200 sites in the following 2 years.

The Superfund site inventory includes over 26,000 sites. Preliminary assessments have been completed at 22,000 of these sites, and, as of June 1988, 1,177 sites were on the NPL or were proposed for listing.

3.1.2 Superfund Programs

Two EPA response and remediation programs are funded through Superfund. The Emergency Response program provides short-term, immediate cleanup at sites posing imminent danger. Emergency response is typically limited to actions costing less than \$2 million to undertake and requiring less than 12 months to complete. The Remedial Action program addresses longer-term cleanup actions. These actions require full RI/FS studies.

Expenditures on these two programs largely flow through contractors with assigned regional responsibility. Incinerator jobs, however, are usually contracted for separately, either through EPA, the Corps of Engineers or the regional contractor. Large-scale emergency response work and all remedial action jobs are put out for competitive bid. To save contracting time, EPA is considering prequalifying incinerator vendors. EPA's obligations on the Emergency Response and Remedial Action programs to date are shown in Table 3-1.

3.1.3 Mobile Incineration at Emergency Response Sites

EPA maintains a data base, called the Removal Tracking System, that summarizes emergency actions since 1981. This system does not contain complete information on removal actions (a significant number of actions have apparently been omitted from the data base) and does not identify actions involving mobile incineration.

Table 3-1 Federal Superfund Obligations
(millions of dollars)

Superfund activity	FY84	FY85	FY86	FY87	FY88*	FY89*
Emergency Response (removal actions)	40.6	61.7	44.1	99.7	94.7	99.8
Remedial Action						
- RI/FS	99.3	101.3	49.5	155.2	152.3	99.5
- Design	6.3	12.0	11.7	44.0	59.4	63.0
- Action	72.9	30.1	43.7	160.7	495.6	383.0
- O&M	0.4	-	-	3.2	.9	8.0
Subtotal	<u>178.9</u>	<u>143.4</u>	<u>104.9</u>	<u>363.1</u>	<u>708.2</u>	<u>553.5</u>
Total	219.5	205.1	149.0	462.8	802.9	653.3

* Estimated.

RI/FS - Remedial Investigation and Feasibility Studies.

O&M - Operations and Maintenance.

Source: U.S. Environmental Protection Agency.

Interviews with EPA Regional staff and with EPA contractors responsible for the Removal Tracking System indicate that only a few of the over 1,000 sites treated since 1981 have employed mobile incinerators.

- o Peak Oil Co. (Tampa, Florida): A Shirco incinerator owned by Haztech (now Westinghouse Environmental Services) burned approximately 7,100 tons of PCB-containing waste oils and sludges at this site between January and October 1987. Region IV staff estimate the cost of the onsite incineration at the site to be \$225 per ton, versus an estimated \$1,500 per ton for removal and incineration at an offsite facility.
- o Florida Steel Corp. (Indiantown, Florida): An O.H. Materials Shirco incinerator burned about 20,000 cubic yards of PCB-contaminated soils at this site. The burn was conducted between June 1987 and March 1988, at a cost of approximately \$3.0 million or about \$250 per ton.
- o Southern Crop (Delray Beach, Florida): This removal action is cleaning up spillage from the mixing and loading of pesticides onto airplanes and will be completed in mid-September 1988. Under Kimmin's direction, Incinerex and Vesta mobile units are being used. Incineration costs are reported to be about \$1.7 million. Up to 5,000 tons of material will be burned.
- o Tibbetts Road (Barrington, New Hampshire): PCB- and dioxin-contaminated soil was incinerated, demonstrating the infrared-thermal technology. Cleanup began in 1984 and was continuing in 1988.
- o Nyanza/Nyacol (Ashland, Massachusetts): A Vesta unit incinerated about 1,600 tons of sludge from dye production contaminated with nitrobenzenes at this site in 1987.
- o Missouri dioxin sites: Small quantities of dioxin-contaminated soils have been excavated at five sites in southwestern Missouri and were burned using EPA's mobile rotary kiln incinerator. The incinerator, located at the Denny Farm site, is currently operated by Enviresponse under contract with Office of Research and Development (ORD). Removal actions have taken place at the following sites:
 - Neosha Wastewater, 125 cubic yards
 - Rusha Farm, 25 cubic yards
 - Erwin Farm, 300 cubic yards
 - Baldwin Park, 250 cubic yards
 - Talley Farm, 125 cubic yards

All of these sites except Neosha Wastewater are within 10 to 15 miles of the Denny Farm site. Neosha Wastewater is 45 miles distant.

Syntex Corporation, the originating source of the dioxin in this area, has expressed interest in taking over operation of the EPA mobile unit after EPA's permit expires in May 1989.

- o American Crossarm (Chehalis, Washington): On June 27, 1988, Vesta was awarded a subcontract of about \$1 million by Riedel, the emergency response contractor for the western part of the United States. Vesta will incinerate about 900 tons of soils and sludge contaminated with creosote, diesel fuel, and pentachlorophenol at the proposed NPL site. Vesta plans to complete the job by the end of 1988.

In addition to these sites, several others are slated for mobile incineration under the emergency response program. These include Aberdeen Pesticide Dumps (Aberdeen, North Carolina), Prentiss Creosote (Mississippi), and Canton (Mississippi). A Vesta mobile incinerator was successfully tested at the Aberdeen site in late 1986; material is now being removed and stockpiled at the site for later onsite incineration. The Prentiss Creosote removal is also under way, although it is at an early stage. Envirite is assembling its large transportable unit at this site, and EPA Region IV expects incineration to begin in August 1988. Between 7,500 and 9,000 cubic yards of material will be burned. The Canton, Mississippi, site also involves creosote wastes. EPA Region IV has not yet put this job out for bid but expects to employ onsite incineration.

EPA's land ban program may stimulate increased use of mobile incinerators for emergency response actions. EPA estimates that approximately 103,000 cubic yards of soil and debris removed in emergency

actions in FY88 through June would have been covered by the "First Third" land disposal restrictions promulgated in August 1988. Based on FY88 volumes, 100,000 to 200,000 cubic yards of material may require alternative treatment, such as mobile incineration, in FY89.

Region IV, in particular, has encouraged the use of mobile incineration through the emergency response program and has given several companies their first field experience. The Region IV sites could have been treated as remedial actions, but the Region chose to conduct the incineration work under the emergency response program, getting the job done more quickly.

3.1.4 Mobile Incineration at Remedial Action Sites

Cleanup actions involving mobile incineration are under way or proposed at a number of NPL sites. In addition, Records of Decision (RODs) signed in FY87 and FY88 specify onsite incineration at 12 sites. Active and proposed incineration projects are described below.

- o Kenai Wildlife Refuge (Alaska): In the early 1970s, a compressor explosion at the Swanson River oil field, located at the Kenai Wildlife Refuge in Alaska, resulted in PCB contamination of soil. The oil-saturated sand was later used for dust control on the refuge's road system.

Sampling by the Alaska Fish and Wildlife Service, owner of the refuge, revealed the extent of the PCB problem in late 1986. ARCO Alaska, the operator of the oil field, excavated between 40,000 and 60,000 tons of soil from the roads and from the original storage pit; this material is now ready for incineration. EPA Region X estimates the total cost of the cleanup will be \$20 million over a 2-year period.

Under CERCLA, the Alaska Fish and Wildlife Service took the lead in obtaining a consent order, to which the Alaska Environmental Conservation Department is also a party. EPA is not a signatory

to the order, but has been closely involved. This use of mobile incineration will represent the first case of onsite disposal of hazardous waste in Alaska. All other hazardous waste has been shipped out of state.

ARCO Alaska had originally proposed a thermal destruction process to be conducted by American Toxic Disposal, Inc. According to EPA Region X, this firm was unable to obtain a demonstration permit, which resulted in delay. Ogden Environmental Services, with a TSCA-permitted circulating bed combustor incinerator in San Diego, was then selected to operate a somewhat larger unit at the refuge. Ogden is seeking a separate permit for the mobile unit to be used on the project and has been able to proceed through the permitting process relatively swiftly.

Ogden will probably obtain a demonstration permit in September and has proposed that EPA give the firm interim approval to process low-level (50 ppm or less) PCB-contaminated soils until the operating permit is approved 2 to 3 months later. Ogden argues that such interim approval will lower its costs of operation and allow continuous employment of local personnel who are being trained for the demonstration. EPA is now considering the Ogden request.

- o Times Beach (Missouri): In eastern Missouri, approximately 100,000 cubic yards of dioxin-contaminated soil require disposal at 26 sites. Four of these are NPL sites: Times Beach, Minker-Stout-Romaine Creek, Ellisville, and Shenandoah Stables. A single ROD is expected to be signed for the Times Beach and Minker-Stout sites sometime during the summer of 1988. Decisions on the other two Superfund sites are not as imminent; non-NPL sites are being pursued through removal actions.

The estimated cost of incinerating 13,600 cubic yards of waste at Times Beach and 12,000 cubic yards at Minker-Stout-Romaine Creek is \$50 million over 5 years. In March 1988, EPA published the proposed plan for onsite thermal treatment at Times Beach. As soon as the ROD is finalized, vendor bids will be accepted. EPA's research incinerator in use in southwest Missouri is not suitable for the quantity and nature of waste to be handled at these sites, according to the Times Beach project manager.

Delisting of the ash residue from dioxin-contaminated material is a potential problem at these sites. Community resistance to locating an incinerator at Times Beach is also a factor. Community opposition scuttled a 1984 proposal to create an Interim Central Storage facility at Times Beach. In public hearings, EPA expects to emphasize the nonpermanent nature of the incineration equipment.

- o Southern Maryland Wood Preservers (Maryland): About 125,000 cubic yards of soil and sludge contaminated with creosote, dioxin, and other substances will be incinerated. The Corps of Engineers is just beginning design work at the site, looking at incineration options ranging from onsite construction to modular onsite units.
- o Delaware Sand and Gravel (Delaware): Region III staff indicate that incineration will be used to process mixed organics and PCBs at this site.
- o Bridgeport Rental and Oil Services (New Jersey): A transportable incinerator is the primary technology being considered for disposal of an extensive PCB contamination problem at this Superfund site. Lagoons located on 14 acres of land contain approximately 80,000 cubic yards of PCB-bearing sludge and sand. Some of this contamination has seeped below the water table. Additionally, 5,000 cubic yards of oil floating on top of the lagoons must be processed.

At a June 29, 1988, public hearing, community members voiced concern about onsite incineration, particularly because a fixed incinerator is located close to the Bridgeport site and could conceivably handle the Bridgeport wastes. This facility, however, apparently does not have the capacity to handle the wastes from the site. The project manager for this site believes that a transportable incinerator, probably requiring a fixed foundation, will be chosen.

- o Boqq Creek Farm (New Jersey): This Region II Superfund site contains 18,000 cubic yards of volatile organics and semiorganics. Remedial design work has been completed; vendor bids will be solicited in the Commerce Business Daily in mid-July. Firms that have contacted the project manager to date include Westinghouse, Ogden, and IT.

The cost of the construction contract for excavating and incinerating waste at this site was estimated during the feasibility study at \$7.5 million. The project manager characterizes this application as a "pretty easy burn"; the compounds have low adsorptive capacity and can be expected to volatilize at relatively low temperatures. The specific incineration technology to be used will be determined through evaluation of contractors' proposals.

- o Caldwell Trucking (New Jersey): After considering the use of a mobile incinerator to destroy 30,000 cubic yards of volatile organics at this site at an estimated cost of \$45 million,

Region II has determined that low temperature volatilization will provide an equally effective remedy at a much lower cost. The low temperature approach is estimated to cost only \$4 million. The base neutrals and metals residue from the process will be deposited in a RCRA-permitted landfill to be constructed onsite.

Roy F. Weston has been retained to review the low temperature volatilization possibilities. This technology may involve the use of a rotary kiln, but at a temperature of 4004 lF, it is not technically an incineration application. Region II may be able to purchase a ready-made new or a used kiln, mount it on a steel frame, and move it by flatbed truck to the site.

Community reaction to this proposal has been positive. The process is expected to take between 15 and 18 months, at the end of which time the landfill will be closed. Design work, through the Corps of Engineers, is under way. Construction contract bids will be let after completion of the Roy F. Weston technology review.

In addition to these sites, in FY87 and FY88 12, Records of Decision have specified onsite incineration. In FY87, 75 RODs were signed. Of these 75 sites, 13 specified either onsite or offsite incineration as part of the remedial strategy, and, of the 13, 10 selected onsite incineration. Through June of FY88, 16 additional RODs had been signed, two of which specify onsite incineration (LaSalle, Illinois, and Old Midland Products, Arkansas). These sites are listed in Table 3-2, with a description of the nature of the contamination at each site.

3.1.5 State Cleanup Actions

In cleaning up State Superfund sites, many States have felt hampered by the fact that they had to go through the RCRA permitting process in order to get equipment working. EPA has stated, however, that State Superfund cleanups do not require RCRA permitting, but are similar to the Federal process.

Table 3-2 Superfund Records of Decision
Specifying Onsite Incineration (FY87 and FY88)

(millions Threat/Problem	Site/Location of dollars)	Cost
<u>FY87:</u>		
Ottati & Goss (NH)	TCE, PCB, VOCs Soil & ground water	8.6 capital 1.7 O&M/yr
Davis Liquid Waste (RI)	VOCs, oily wastes Soil & ground water	10.4 capital 4.5 O&M/yr
Geiger (SC)	PCBs, organics Soil & ground water	5.6 capital 0.4 O&M/yr
Sodyeco (NC)	VOCs Soil & ground water	2.1-3.9 PV
Tower Chemical (FL)	Pesticides, metals Soil & ground water	6.8 capital
Laskin/Poplar (OH)	PCBs, VOCs Soil	8.5 PV
Rose Township (MI)	PCBs, VOCs, TCE Soil & ground water	32.5 capital 0.2 O&M/yr
Bayou Bonfouca (LA)	PAHs Soil & ground water	25.0 capital 0.1 O&M/yr
Cleve Reber (LA)	Organics Soil & ground water	59.6 capital 0.2 O&M/yr
Hardage/Criner (OK)	PCBs, VOCs, TCE Soil & ground water	68.0 capital 2.3 PV
<u>FY88:</u>		
LaSalle Electric (IL)	PCBs Soil & ground water	28.6 PV
Old Midland Products (AR)	Creosote, PCP Soil & ground water	10.3 PV

O&M - Operations and maintenance.

PV - Present value.

Source: U.S. EPA Records of Decision

Prior to this decision, the State of Illinois took aggressive steps to encourage the use of mobile incineration to clean up some of its hazardous waste sites. According to Jim Frank, Manager of the Illinois Hazardous Waste Cleanup Program, the State wants to prove that State-sponsored cleanups can be conducted responsibly and efficiently without the procedural site-specific approvals that EPA has typically required. As a result, the State obtained a statutory exemption from EPA permitting requirements for use of mobile incineration units at Illinois hazardous waste sites. This exemption is limited to 3 years. So far, work has begun at two sites (Lenz Oil and Beardstown) and a third (LaSalle) is about to commence.

- o Lenz Oil: At this site, ENSCO is using a transportable rotary kiln to decontaminate 7,000 tons of soil and sludge and to incinerate the contents of 200 drums and several thousand gallons of hazardous wastes.
- o Beardstown Lauder Salvage Yard: To clean up between 5,000 and 10,000 tons of PCB-contaminated soil at this site, Roy F. Weston has built a 5-ton-per-hour rotary kiln incinerator. As of the beginning of June, Weston was at the trial burn stage.
- o LaSalle: Westinghouse will use its Shirco unit to clean up about 230,000 tons of PCB-contaminated soil. The contract is reported to be for \$11.7 million.

3.1.6 Mobile Incineration at PRP Sites

Some NPL sites will be cleaned up using private funds. A number of the companies expressed interest in this work, but apparently very few privately funded sites have used mobile incineration to date. One site that is proceeding is the Motco site in LaMarque, Texas. On January 6, 1988, IT was awarded a \$28.3 million contract to incinerate liquids and

solids. The site is 27th on the NPL list, and 22 responsible parties are financing the cleanup.

Companies are also interested in corrective action cleanups, but find that because of RCRA permitting requirements, firms are sending wastes offsite rather than dealing with the costs and time associated with permitting a mobile incinerator to work onsite.

3.2 Department of Defense Cleanup Activity

The Department of Defense (DOD) owns and operates over 5,000 sites that have been identified as potentially contaminated with hazardous wastes. In addition, DOD has inventoried 7,177 formerly used properties where contamination or related problems may be an issue.

CERCLA and SARA prohibit the use of Superfund monies for remedial actions at Federally owned sites. To address problems at DOD installations, the Defense Appropriations Act of 1984 created the Defense Environmental Restoration Account and provided for central coordination of the Military Services' environmental restoration programs under the Defense Environmental Restoration Program (DERP).

Since 1985, EPA has been authorized to place Federally owned facilities on the National Priority List (NPL). As of June 1988, DOD had 31 sites on the NPL and 23 sites proposed for listing.

In addition to installation cleanups, in February 1988, the Army announced that it would destroy its chemical weapons stockpile using onsite incinerators at the eight sites where these materials are stored. The total budget for the Chemical Stockpile Disposal Program is \$3.1 billion (current dollars), allocated as shown in Table 3-3.

From the limited description of the chemical demilitarization program currently available, it appears that the Army will not employ mobile or transportable units to incinerate these wastes. Rather, the program will fund the construction of dedicated onsite units that meet the design criteria for chemical weapons destruction.

3.2.1 The DOD Cleanup Process

All DOD sites, regardless of whether they are on the NPL, go through the same basic stages of identification, assessment, and remedial action as other sites being reviewed by EPA. These stages are:

- o Preliminary Assessment and Site Inspection (PA/SI): Collection of information on the source, nature, and extent of the hazardous release.
- o Hazard Ranking System (HRS): Ranking by EPA based on the data resulting from the PA/SI to establish the relative severity of contamination and the priority for remedial action.
- o Remedial Investigation and Feasibility Studies (RI/FS): Comprehensive investigation of the public health and environmental risks associated with individual sites, and evaluation of alternative remedial action strategies.
- o Federal Facilities Agreement: Formation of interagency agreements, as mandated by SARA for sites placed on the NPL, to govern execution and timing of remedial action.
- o Defense Site Remediation Priority Model: Use of this model, starting in FY89, to set remedial action priorities for the entire DOD inventory of sites across all services.

Table 3-3 Chemical Weapons Stockpile Disposal Program
Funding Requirements by Fiscal Year
(millions of current year dollars)

Year	R&D	Procurement	O&M	Subtotal	Construction	Total
FY88	4.9	96.6	97.0	198.5	-	198.5
FY89	17.9	44.3	112.3	174.5	58.0	232.5
FY90	24.5	173.9	149.1	347.5	27.0	374.5
FY91	7.7	188.0	139.0	334.7	101.1	435.8
FY92	12.5	323.8	148.5	484.8	134.6	619.4
FY93	8.8	161.6	266.2	436.6	0.0	436.6
FY94	7.7	7.3	226.3	241.3	0.0	241.3
FY95	3.3	5.6	292.4	301.3	0.0	301.3
FY96	0.0	0.0	231.0	231.0	0.0	231.0
FY97	0.0	0.0	65.3	65.3	0.0	65.3
Total	87.3	1,001.1	1,727.1	2,815.5	320.7	3,136.2

R&D: Research and development.
O&M: Operation and maintenance.

Source: Chemical Stockpile Disposal Program - Implementation Plan,
Program Manager for Chemical Demilitarization, March 15, 1988.

- o Remedial Design and Remedial Action (RD/RA): Design and implementation of cleanup actions, with planning for future maintenance and ongoing monitoring.
- o Ongoing Maintenance and Monitoring: Performance of maintenance and monitoring either after remediation or at sites where the RI/FS indicates no current need for remediation.

3.2.2 The DOD "Pipeline"

DOD cleanup sites are categorized as (1) completed, (2) under way, or (3) scheduled for future study or action. The "future study" designation is given to those sites that are near enough to the end of one stage to be able to anticipate the need for the next stage.

At each stage of work, the number and definition of sites being investigated at an installation may change, reflecting new information or changing opinions about the nature of the contamination and the most effective strategies to remediate it. Thus, the numbers of sites listed by DOD in various stages of work do not sum to a single inventory total.

The assessment of environmental damage and risk at active installations has been the DERP's priority since FY86. As of the end of FY87, Preliminary Assessments/Site Inspections (PA/SIs) had been completed at all major military installations, involving a total of 3,735 sites (see Table 3-4 for details). The remaining 78 sites are listed as having PA/SI work under way. The Department of Defense considers this stage of the cleanup process to be virtually complete. Approximately 76 percent of DERP funding has been devoted to the investigation and cleanup of contamination from past activities at both active installations and formerly used properties.

Table 3-4 DOD Installation Restoration Status: 1987

	PA/SI		RI/FS			RD/RA		
	C	U	C	U	F	C	U	F
Army	608	2	245	356	78	33	60	66
Navy	913	31	499	428	12	6	112	317
Air Force	2,203	45	342	1,937	78	86	624	394
DLA	11	0	10	12	1	1	4	9
Total	3,735	78	1,096	2,733	169	126	800	786

C = Cumulative total of sites completed by end of FY87.

U = Number of sites under way at end of FY87.

F = Number of sites scheduled for future study/action.

DLA = Defense Logistics Agency.

PA/S = Preliminary Assessments/Site Inspections.

RI/FS = Remedial Investigations/Feasibility Studies.

RD/RA = Remedial Design/Remedial Action.

Source: Defense Environmental Restoration Program, Annual Report to Congress for Fiscal Year 1987.

Similarly, progress in the RI/FS stage has been significant. At the end of FY87, Remedial Investigations/Feasibility Studies (RI/FSS) had been completed at 1,096 sites and were under way at 2,733 sites. This was an increase of 800 sites over the previous year. An additional 169 sites were scheduled for future action.

The emphasis of the DERP in coming years will be to complete the RI/FSSs and move into the Remedial Design/Remedial Action (RD/RA) stage of work at sites. RD/RA work was under way at 800 sites at the end of FY87 and was scheduled at an additional 786 sites.

Formerly used properties are included in DOD's Environmental Restoration Program but are not included in the Installation Restoration Program (IRP) figures shown above. The inventory of 7,177 identified formerly used properties is still in a relatively early stage of investigation. Fewer than 10 percent of these sites have had completed investigations, and 20 percent are under investigation.

Remedial action at formerly used properties probably will focus more on the demolition and removal of old buildings than on the cleanup of hazardous wastes. During FY87, 34 cleanup projects were under way at formerly used DOD sites.

3.2.3 Projected Installation Restoration Expenditures

The Department of Defense has estimated that the IRP will cost \$11 to \$14 billion (in FY87 dollars) over 25 years. Spending to date from the Defense Environmental Response Account totals \$1.6 billion (FY84 through FY88), with an increasingly large percentage being devoted to the IRP. Over the 5-year period, the IRP has accounted for 76 percent of the funds expended.

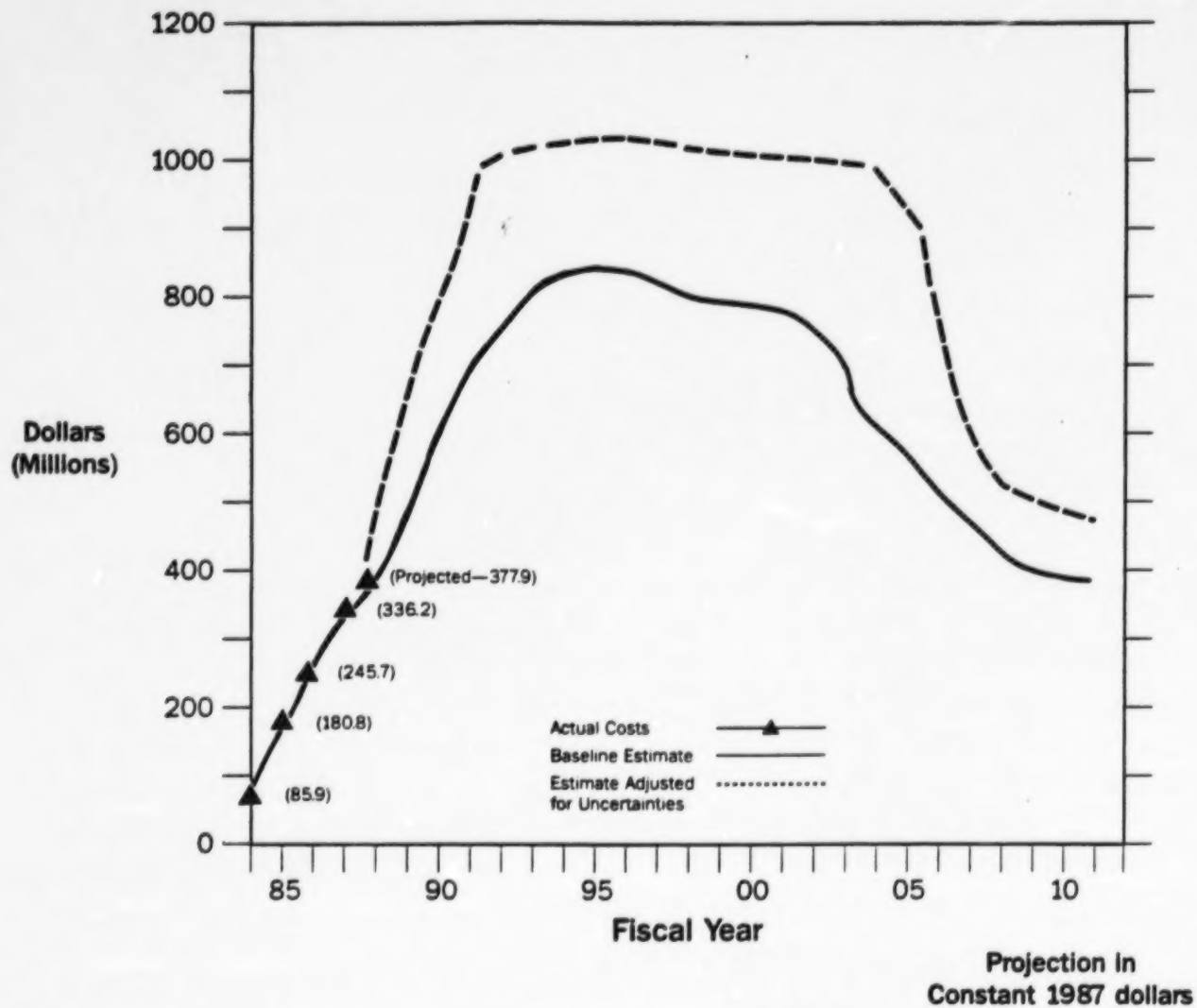
Figure 3-1 shows the growth in IRP funding and DOD's projections of expenditures in future years. (A DERP budget request of \$500 million has been submitted for FY89, of which over 90 percent will be allocated to the IRP.) In DOD's long-range projection of program funding requirements, expenditures peak in fiscal year 1995 and decline to 1988 levels by the year 2010.

It is estimated that PA/SI and RI/FS work has accounted for about 75 percent of expenditures to date, with the remainder in RD/RA (cleanup). As sites move from the RI/FS stage to the RD/RA stage, these proportions should reverse.

DOD estimates the average cost per site increases by an order of magnitude with each stage. In 1986, the Agency cited the following average costs per site:

- o PA/SI: \$80,000
- o RI/FS: \$800,000
- o RD/RA: \$8-80 million

Published cost data for the Twin Cities Army Ammunition Plant in Minnesota, where remedial action is already far along, illustrate the relative costs associated with the different stages of work. Based on actual expenditures through FY87 and planned expenditures from FY88 through FY90, total costs by stage of work are shown in Table 3-5.



Source: Defense Environmental Restoration Program, Annual Report to Congress for Fiscal Year 1987, March 1, 1988, p. 15.

Figure 3-1 Funding for Installation Restoration Program

Table 3-5 Twin Cities Army Ammunition Plant Cleanup Costs

	Cost (\$) (millions of dollars)	Percent
PA/SI	0.4	1.4
RI/FS	6.0	20.6
RD/RA	21.4	73.5
Monitoring	<u>1.3</u>	<u>4.5</u>
Total:	29.1	100.0

Source: Defense Environmental Restoration Program, Annual Report to Congress for Fiscal Year 1987, March 1, 1988, p. 17.

3.2.4 Mobile Incineration at DOD Installations

Mobile or transportable incinerators are active at or are under consideration for several DOD sites in the cleanup of ordnance and soils contaminated with explosives. These sites are described below.

- o Cornhusker Army Ammunition Plant (Nebraska): The Army Corps of Engineers, through its Omaha District, contracted with IT Corporation to incinerate soil contaminated with explosives using a transportable rotary kiln incinerator at this NPL final site. Incineration of approximately 40,000 tons of soil contaminated with low concentrations of RDX and TNT is complete at the site.
- o Louisiana Army Ammunition Plant (Louisiana): The IT transportable rotary kiln now active at Cornhusker is being moved to the Louisiana Army Ammunition Plant, a proposed NPL site. Approximately 120,000 tons of sludge and soils will be incinerated.

According to sources at the U.S. Army Toxic and Hazardous Materials Agency (USATHMA), the Army had originally proposed to purchase an incinerator for use at the Cornhusker and Louisiana sites. Because of the small number of manufacturers of mobile/transportable incineration equipment, the Army received few bids. Contracting for service proved to be a more competitive and hence less costly route.

IT Corporation won the site-specific award for the Cornhusker operation, with the understanding that the second contract for the higher volume work at Louisiana would be linked. Obtaining a permit for the incinerator involved considerable negotiation between EPA, State authorities, and the Corps, and was complicated by the fact that Cornhusker is a final NPL site, while Louisiana is a proposed site.

- o Savanna Army Depot (Illinois): USATHMA is considering onsite incineration of 25,000 tons of explosives in soil at this proposed NPL site. The FY87 Annual Report of the Defense Environmental Restoration Program states that incineration of TNT-contaminated soils at the site is scheduled for 1988. However, as of this writing, USATHMA states that it is not ready to begin contracting for remedial action at Savanna.

- o Fort A.P. Hill (Virginia): This Army installation contains a small amount of dioxin-contaminated material in drums, apparently in low levels of concentration. USATHMA cites this as a case in which use of EPA's mobile incinerator might be appropriate.
- o Weldon Spring Training Area (Missouri): The Kansas City District of the Corps is in the early stages of design work for this DOE/Army installation. The Corps is actively investigating the use of mobile incineration for TNT and DNT contaminants.
- o Gulfport (Mississippi): The Air Force awarded a \$7 million contract to ENSCO to clean up 10,000 to 20,000 tons of dioxin-contaminated soil.

3.2.5 Community Reaction to Mobile Incinerators at DOD Sites

In none of the above cases has the Army encountered significant community opposition. Officials at USATHMA state that mobile incineration may be an attractive option at a number of similar Army operations; however, no demand forecasts or projections of the number of likely sites have been made.

Nevertheless, Army Corps spokesmen note that the significant community opposition encountered over the use of mobile incineration at the Woodbury Chemical site in Colorado may have affected the selection of the type of remedial action to be used at Rocky Mountain Arsenal, also in Colorado. According to staff in the Omaha District, mobile incineration would have been the technology of choice at Rocky Mountain Arsenal. Because of the strong objections of city and community forces related to the Denver Radium sites, however, waste was shipped to South Carolina at a cost seven times higher than that of onsite disposal. Had onsite incineration been accepted at this site, the way might have been paved for a similar approach at Rocky Mountain Arsenal.

3.3 RCRA "Live Stream" Wastes

Of the approximately 300 million metric tons of "live stream" hazardous wastes treated and disposed of annually in the United States, a relatively small amount--2.1 million metric tons, or about 0.7 percent--is incinerated. EPA reports that 400,000 metric tons is incinerated at 14 offsite commercial facilities, and the remainder is incinerated at the 175 onsite noncommercial facilities.

The amount of waste treated by incineration has grown significantly in the 1980s as a result of liability concerns on the part of generators and, most recently, EPA's land disposal restrictions. The shift to incineration will continue, at least in the near term, as EPA's land bans take effect.

Mobile incinerators may benefit from this trend if permitting obstacles can be overcome. At this time, no mobile incinerators appear to be active in onsite RCRA waste disposal. Companies cite the lengthy permit process as a major obstacle to onsite incineration of RCRA wastes, but they are encouraged by EPA's proposed rulemaking that eases permit requirements for mobile treatment units. Several companies see potential in the RCRA market, either through "circuit-riding" to generators using a small mobile unit or incinerating wastes at a series of regional waste collection points.

3.4 TSCA PCB wastes

PCB wastes are amenable to treatment through incineration. EPA has established a nationwide permitting program that many companies cite as the way they would like to see mobile units permitted under RCRA.

Through a rulemaking dated March 30, 1983, EPA transferred the review and approval authority to Headquarters for mobile and other PCB facilities that are used in more than one EPA Region. This means that companies can obtain a nationwide permit for PCB disposal. Then, in advance of work at a specific site, they can simply notify in writing EPA Headquarters and Regions, as well as State and local officials. EPA Headquarters officials state that these permits are typically taking approximately 1 year to obtain.

Most companies are anxious to acquire a TSCA permit for their mobile units. While one representative felt that the permit primarily served as a marketing tool, it does provide companies with an opportunity to run burns of PCB material and prove their effectiveness. In cases in which the company is bidding on a site that has PCB contamination, the permit demonstrates and confirms its capabilities. As of April 1988, five mobile units had permit applications in process and two units were already permitted.*

* Since April 1988, at least one more unit has acquired a PCB permit.

4. MARKET ANALYSIS

4.1 Current Market

The market for mobile incineration is new, rapidly changing, and highly competitive. The lure of major remediation programs funded through Superfund (\$8.5 billion over 5 years) and the Department of Defense (\$14 billion over 20 years) has drawn many new entrants into the market, as described in the company profiles in Section 2. At the same time, few projects have become available. Thus, at this point in the evolution of the market, it is a buyer's market, with many contractors chasing a small number of potential contracts.* While this phenomenon may be only temporary, it is the key to understanding the current dynamics of the market.

The most striking features of today's market are significant excess capacity, downward price pressure, and construction of new units prior to project commitments.

4.1.1 Significant Excess Capacity

In 1987 and over the first half of 1988 almost 70,000 tons of waste were incinerated using onsite mobile units. (See Tables 4-1 and 4-2 for a summary of mobile incineration jobs completed or under way as of mid-1988.) On the other hand, over 400,000 tons of mobile capacity exists and is field-ready. Clear evidence of this excess capacity is demonstrated by the fact that at least four units are currently idle:

* One company stated that over 50 firms attended a bidders' conference on a \$50 million cleanup. Twenty groups of contractors planned to bid.

Table 4-1 Completed Mobile Incineration Cleanups

Site		Cost (millions of dollars)	Tons	Vendor	Start date	End date
Cornhusker	NE	5.0	38,000	IT	unknown	7/88
Florida Steel	FL	3.0	20,000	O.H. Materials	6/87	3/88
Missouri dioxin	MO	unknown	825	EPA	unknown	unknown
Nyanza	MA	1.6	1,600	Vesta	9/87	12/87
Peak Oil	FL	<u>1.6</u>	<u>7,100</u>	Haztech	1/87	10/87
Total		11.2	67,525			

Source: Interviews with EPA and company officials; written materials.

Table 4-2 Mobile Incineration Cleanups Under Way

Site		Cost (millions of dollars)	Tons	Vendor	Start date
American Crossarm	WA	1.0	900	Vesta	6/88
Beardstown	IL	2.7	7,500	Weston	10/86
Gulfport	MS	7.0	15,000	ENSCO	unknown
Kenai/ARCO	AL	20.0	50,000	Ogden	7/88
LaSalle Electric	IL	11.7	230,000	Westinghouse	unknown
Lenz Oil	IL	4.7	7,000	ENSCO	6/87
Louisiana Ammo	LA	unknown	120,000	IT	7/88
MOTCO	TX	28.3	unknown	IT	unknown
Prentiss	MS	1.6	9,000	Envirite	unknown
Tibbets Road	MA	2.0+	unknown	unknown	84
Tillie Lewis	CA	unknown	7,000	Ogden	88
Southern Crop	FL	1.8	5,000	Kimmins/Incin	88
Vertac	AR	unknown	<u>unknown</u>	IT	88
Total			451,400		

Source: As of July 1988. Interviews with EPA and company officials; written materials.

ENSCO (two), Riedel (one), and O.H. Materials (one). While this capacity excess could dissipate very rapidly as Superfund remediation contracts are let, in the near term it exerts downward pressure on prices and forces new entrants to obtain units to compete with existing field-ready units.

4.1.2 Downward Price Pressure

Prices for onsite incineration have fallen from \$500 per ton several years ago to less than \$200 per ton on several recent bids. The signs of heavy competition include the fact that some companies believe that competitors are "lowballing" bids. The primary reason for lowballing a bid is to enable a company to get a unit into the field in order to build expertise and demonstrate capability. Companies may also bid aggressively, at low profit margins or at cost, to win bids and keep their equipment utilized. The costs of carrying idle equipment can be a significant financial drain. As a result of these forces, recent bidding on contracts shows significant differences between high and low bids.*

4.1.3 Construction of New Units Prior to Project Commitments

To complete the vicious cycle created by today's buyer's market, new entrants now find it necessary to build mobile units in anticipation of

* A good example is the range of bids on the Prentiss, Mississippi, emergency removal action. Nine bids were received, ranging from \$172 per ton to \$501 per ton, with a median bid of \$322. The low bid was made by Envirite, which won the contract. This site was the first use of the firm's incinerator. For a discussion of the Prentiss site, refer to the paper presented by Thomas F. McGowan (Envirite) and Kelly S. McCarty (USEPA Region IV), "Prentiss Creosote Superfund Incineration Project," at the International Conference on Incineration of Hazardous, Radioactive and Mixed Wastes, University of California at Irvine, May 5, 1988.

contracts to compete with firms that have idle units ready for deployment. This has the effect of adding to the capacity excess. In the past, some companies felt that they could win a bid without a field-ready mobile incineration unit. New entrants now believe that they need to have units ready for use to be competitive.

4.2 Advantages of Mobile Incineration

Mobile incineration offers a number of advantages over fixed-site incineration and over other offsite waste disposal options:

1. There is less community opposition to temporary units. Generally, most companies have found that public reception of mobile units has been favorable. This is not to say that companies and States have not had to work closely with communities on the siting of mobile units. In general, however, the public is anxious to have waste sites cleaned up and pleased that the incinerator will leave the site.
2. Transportation liabilities and costs are eliminated. By cleaning up onsite, mobile incinerators eliminate the step of moving waste to another treatment site, thereby removing any potential liability the generator might have for the waste after it leaves the site. In addition, the transportation of large quantities of waste to a fixed-base incinerator is a significant expense. For example, Region IV staff estimated that the cost of offsite removal and incineration of waste at the Peak Oil, Florida, site would have approached \$1,500 per ton versus \$225 per ton for an onsite infrared unit. The larger the site, the more transportation costs become a concern; for very small sites (those under about 1,000 tons), offsite disposal may be more economic.
3. Incineration is a final solution. Companies market mobile incineration as a "final" solution to a waste problem. The hazardous elements are destroyed and residuals may be dealt with more easily. Generators may be able to avoid continuing liability for their wastes.

4.3 Obstacles

The main concerns that companies expressed center around government permitting and procurement processes.

4.3.1 RCRA Permitting Process

No company interviewed believes that RCRA wastes are now a viable market for mobile incinerators. The length and site specificity of the permit process pose a barrier that companies find uneconomic to overcome. Most companies, while reserving judgment, are hopeful that EPA's proposed changes to its permitting rules for mobile treatment units will ease the barriers to the use of mobile incinerators in the RCRA market. One company, which has small units, sees some potential in a "circuit-riding" type of business. Others, especially those with larger units that have long setup and disassembly times, do not see RCRA as a market for their transportable units. Some firms are considering regional incineration treatment systems that could serve smaller generators economically, perhaps using a mobile unit that could be moved among several sites, each of which would serve as a collection point for wastes from local generators.

The RCRA permitting process also poses a serious obstacle to onsite, privately sponsored corrective actions. Company representatives generally estimate that RCRA permits take about 2 years to obtain. A number of firms mentioned that generators were often opting to send wastes offsite to a landfill rather than to use onsite incineration, largely because of the time involved and problems associated with the RCRA permit process.* Industry people believe that this inclination may

* One company estimated that the permitting costs would be \$150,000 and thus decided to send its wastes to a landfill rather than use a mobile incinerator.

be affected by the land disposal restrictions of organic wastes, but it still could lead companies to transport wastes to an already permitted fixed-site incinerator rather than to use a mobile unit.

Companies also have had difficulty obtaining approvals for State-sponsored cleanups. Illinois's statutory exemption from Federal permits for mobile incinerators has accelerated up the process at Illinois sites and is giving companies opportunities for work with fewer bureaucratic hurdles.*

4.3.2 Aggressive Competition

As noted above, several companies complain that their competitors are engaging in "predatory pricing" and are bidding prices on projects that these companies view as uneconomic. In actuality, companies are anxious to win bids for several reasons. First, to be considered for a project, companies feel that they need to have a track record, and to obtain that track record, they have to win a bid. Therefore, they may bid low in order to gain experience. Second, in the past companies wanted to win a bid to finance the construction of a unit. (This is no longer the case as more companies now have field-ready units.) Third, companies that already have units must keep them occupied, and this may cause them to bid very competitively. As discussed previously, aggressive bidding is a sign of the excess capacity and extreme competitiveness of this market.

* Roy F. Weston representatives reported that the permit process for their Illinois project took 8 months, as opposed to a typical processing period of 11 to 18 months.

4.3.3 The Government Procurement Process

Superfund and Department of Defense remedial actions are a major market for most companies. These projects are large and there are many potential jobs in the pipeline. However, some companies do not want to, or are unable to, participate in these markets.

For smaller companies in particular, the process sets up barriers to entry. The costs of the bidding process are high, generally several hundred thousand dollars. The process is also slow; Roy F. Weston estimates that it typically takes 2 years to get from the request for a proposal (RFP) to signed contract.* Smaller companies may not be able to gamble that kind of money or time. In addition, small and even some larger companies may not be able to meet bonding and other contractual requirements. As one employee of a small company noted, the Superfund remedial action work is "high risk, low return."

Also significant is the time that elapses between the evaluation and choice of a remedial technology for a Superfund site and the selection of the contractor to undertake that remedial action. Because of the rapidly evolving nature of the industry, the information upon which the choice of remediation technology is based may be out of date. Specifically, costs have fallen dramatically in the past 2 years, however, several firms feel that mobile incineration may be eliminated from consideration at some

* One company stated that a 1-year delay in the contracting process cost them \$150,000.

sites because of a false perception of its high costs. This problem is lessening, but one can imagine similar future systematic lags in recognizing new technologies, capabilities, and costs.

Finally, the unpredictable timing of Federal funding makes it difficult for companies to plan and respond to Federal needs. This unpredictability has led companies to be conservative about their plans and commitments. Several companies reported that they had partially constructed equipment on hold, had equipment in storage, or were using equipment at a fixed-site incinerator. Furthermore, while they see a large number of potential projects, many feel that these projects are not realized because of the pace of the remedial action program.

4.4 Future Market

The sheer size of the potential market for mobile or transportable incineration is impressive. Jobs totaling over 600,000 tons are likely to be put out for mobile incineration bids (see Table 4-3). This quantity of work seems to be well within the capability of the estimated industry capacity of about 800,000 tons per year. So far, capacity constraints do not seem to be limiting the use of mobile incinerators. The barriers to entry appear significantly lower than, for example, those of fixed-base incinerators, a market in which there have been no new entrants since the advent of the Federal hazardous waste program in

Table 4-3 Likely Mobile Incineration Jobs

Site	State	Cost (millions of dollars)	Tons
Aberdeen Golf Course	NC	unknown	unknown
AMOCO Sugar Creek	LA	unknown	300,000
Bog Creek	NJ	7.5	18,000
Breaux	NJ	unknown	unknown
Bridgeport	NJ	unknown	85,000
Canton	MI	unknown	unknown
Del. Sand & Gravel	DE	unknown	unknown
Fort A.P. Hill	VA	unknown	unknown
Old Midland	AR	11.6	23,000
Savanna Ammo	GA	unknown	25,000
Southern Maryland	MD	unknown	125,000
Times Beach,	MO	50.0	25,600
Minker-Stout-Romaine Creak			
Love Canal	NY	<u>28.5</u>	<u>35,000</u>
Total		97.6	636,600

Source: Interviews with EPA and company officials and written materials.

1980. Instead, growth in the mobile incineration market appears to be impacted by Federal cleanup programs such as Superfund.

Given the competitiveness of the mobile incineration market and the pace of the remedial action program, some casualties or dropouts among the smaller, less well-funded firms are likely. While the costs of entering the mobile incineration market are not large relative to the revenue base of many of the firms now in the business, for smaller firms these costs may be significant. One early entrant, Shirco, declared bankruptcy within the last year.* Companies with a sufficiently broad and diverse financial base to absorb the business risk or those able to exploit a market niche are most likely to survive.

* As of January 1989, other companies have also run into problems. Williams Environmental has bought Envirite's field services, and ENSCO is dismantling its field services and auctioning off its incinerators.

APPENDIX A
List of Contacts

Name	Organization
Tom Atwood	Waste-Tech Services
Frank Bader	U.S. Army Corps of Engineers (Kansas City)
Scott Berdine	Ecova
Fred Cataneo	U.S. Environmental Protection Agency (Region II)
Lt. Col. Kenneth Cornelius	U.S. Air Force, Office of the Secretary
Mike Cosmos	Roy F. Weston
Harold Diot	Ogden
Dody Dodehara	U.S. Environmental Protection Agency (Washington, D.C.)
Kevin Doxey	U.S. Department of Defense, Defense Environmental Restoration Program
Dana Duxbury	Tufts University, Center for Environmental Management
Bruce Englebert	U.S. Environmental Protection Agency (Washington, D.C.)
Peter Falcon	Rollins Environmental
Bob Field	U.S. Environmental Protection Agency (Region VII)
Ed Finnerty	U.S. Environmental Protection Agency (Region II)
Rick Foote	Riedel
Jim Frank	State of Illinois

APPENDIX A (continued)

Name	Organization
Linda Galer	U.S. Environmental Protection Agency (Washington, D.C.)
Colleen Getz	U.S. Senate, Committee on Armed Services
John Gilbert	U.S. Environmental Protection Agency (Ohio)
Bill Hagel	U.S. Environmental Protection Agency (Region III)
Bill Herman	John Zink
Dorothy Hyatt	Brooks Air Force Base
Tricia Jack	Vesta
Gary Kepco	U.S. Environmental Protection Agency (Region VII)
John Kingscott	U.S. Environmental Protection Agency (Washington, D.C.)
Col. McAler	U.S. Army, Toxic and Hazardous Materials Agency
Frank McAllister	U.S. Environmental Protection Agency (Washington, D.C.)
Greg McCartney	O.H. Materials
Mike Mann	Chemical Waste Management
Richard Martin	John Zink
Gary Martini	ENSCO
Bob Moody	Kimmins
Harold Peters	State of California

APPENDIX A (continued)

Name	Organization
Bob Quinn	U. S. Environmental Protection Agency (Washington, D.C.)
Bill Reed	Westinghouse Environmental Services
Rick Schwartz	U.S. Environmental Protection Agency (Region II)
Jim Secord	Penberthy Electromelt
Ed Shuster	Envirite
Bob Smart	U.S. Army Corps of Engineers (Kansas City)
Kevin Smith	IT
Sonya Stelmack	U.S. Environmental Protection Agency (Washington, D.C.)
Fred Stroud	U.S. Environmental Protection Agency (Region IV)
Andrew Talts	U.S. Department of Defense, Defense Environmental Restoration Program
Robert Terkeltaupe	U.S. Army, Toxic and Hazardous Materials Agency
Col. Steven Termath	U.S. Air Force, Office of the Secretary
Steven Torok	U.S. Environmental Protection Agency (Region X)
Jim Vickery	U.S. Environmental Protection Agency (Washington, D.C.)
Ken Welhelm	State of California